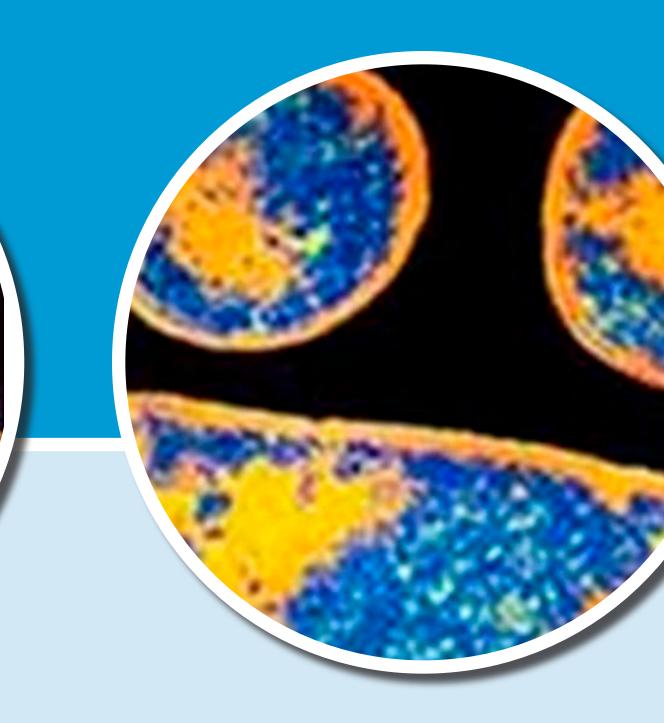
Investigation of Clostridium Botulinum in Infants at Fort Meade

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Abstract

Background: Incidence rates for infant botulism are estimated at 2:100,000 each year in the US. Within a three month period, Ft. Meade experienced two cases of infant botulism within the same local community. The infants lived approximately 400 ft. apart and in the same neighborhood.

Methodology: Interviews were conducted using an infant botulism questionnaire that was modified with questions for military personnel. Stool specimens were collected by local physicians and tested by the Maryland Department of Health and Mental Hygiene. Risk communication was performed for local residents as well as local media.

Results: Stool specimens collected from both infants tested positive for *Clostridium Botulinum* toxin B, known to be endemic to eastern US. Interviews with each family revealed little as to the likely source of the outbreak. Suspicion did develop for environmental factors that were discussed in the interviews, such as construction sites and flooding.

Discussion/Conclusion: Subtyping has been an integral part of outbreak investigations since the technology became available. However, given the small numbers of infant botulism cases in the US each year, developing a library for genotypes is an ongoing process. Given that limitation, we are not able to confirm a relationship among the cases. No apparent commonalities were seen in the interviews. In fact, interviews with both families show a number of differences between each case. Known exposures such as honey and syrup were not present for either of the cases.

Recommendations: A number of recommendations have come from performing this investigation. The CDC recognizes the need for it to develop a library of botulism toxin B for subtyping comparisons. In addition, more research in the civilian community should be expended at looking for known risk factors for infant botulism.

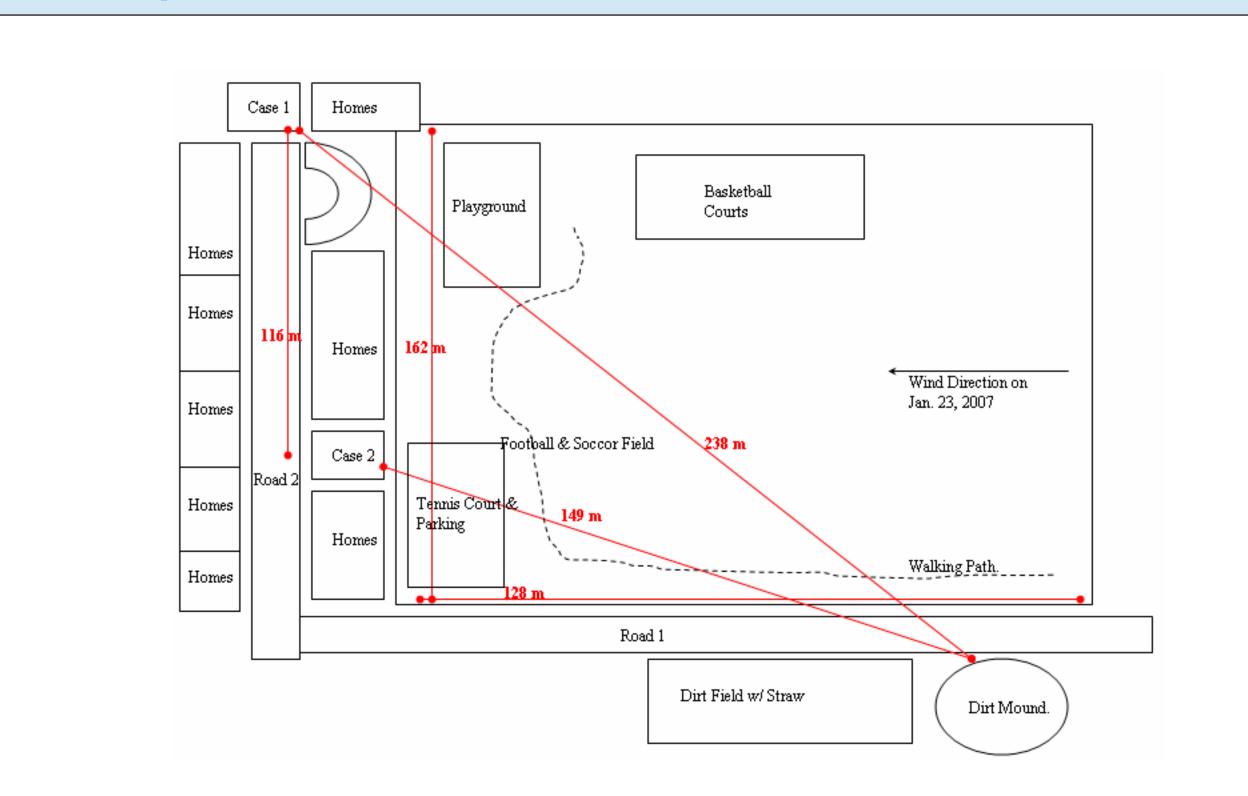
Background

- *C. botulinum* is an anaerobic spore-forming, rod-shaped bacterium that produces botulinum neurotoxin, the causative agent of botulism. C. botulinum is known to produce seven distinct toxins including A, B, C I, D, E, F, and G. Release of these toxins at presynaptic nerve terminals causes paralysis.
- *C. botulinum* in infants is the most commonly diagnosed type of botulinum intoxication in the U.S.; despite this, only about 2 infant botulism cases are known to occur annually for every 100,000 live U.S. births.
- The case fatality rate for infant botulism in the U.S. is about 1.3 percent and less than 1 percent for hospitalized infants.
- In late 2006, two cases of infant botulism type B were identified among Department of Defense (DOD) beneficiaries hospitalized at the Walter Reed Army Medical Center (WRAMC). The cases occurred approximately 3 months apart and the infants involved lived in the same residential area in Fort Meade, Maryland, approximately 116 meters apart.

Methods

- Four Epicon team members conducted the interviews with the parents of each case using a modified CDC investigation form.
 Each interview lasted for approximately 1 hour.
- Both DMSS and M2 were queried to identify infant botulism cases diagnosed among military health system beneficiaries from calendar year (CY) 2002 through CY 2006.
- The Defense Enrollment Eligibility Reporting System (DEERS)
 was then queried to determine live births among DOD active
 duty beneficiaries for CY 2003 through CY 2006.
- Sampling of environmental sources for *C. botulinum* type
 B was strongly considered by all parties involved in the
 investigation. After consulting with experts in the field, it was
 determined that environmental sampling would not add to
 this investigation and thus it was not conducted. However,
 collaboration with, and submission of environmental samples
 to, the Infant Botulism Treatment and Prevention Program in
 California was offered as part of long-term research and may
 occur in the future.
- A layout of the immediate construction sites and the cases' residences was developed using a measuring wheel for distances. Prior land use was also thoroughly researched for any possible *botulinum* contamination or biological use that may induce growth of *C. botulinum*.

Figure 1: Layout of Case-Patient Residences and Possible Soil or Dust Exposures



Results

- Neither of the mothers were prescribed antimicrobials prior to the onset of illness in their respective infants. Both families shop for groceries at the same locations and both infants were born in local hospitals. Feeding patterns are on the same schedule, but the second casepatient was typically fed with supplement, whereas the first case-patient had been feeding on breast milk.
- Case-patient 2 does access the local child development center (CDC II), while case-patient 1 has never utilized the facility. The children did not share any other known commonalities such as people, churches, gathering centers, etc. All four parents of the children had different occupations and were at different localities for their respective positions.

 Review of public health reports revealed that a total of 16 laboratory-confirmed cases of infant botulism were reported in Maryland from 1976 through 1996. The Anne Arundel County Department of Health had documented 30 laboratory-confirmed cases during this time frame, bringing the cumulative 30-year total to 46 cases. Case reports were sporadic, ranging from 0 to 6 cases reported per year. The 2005 incidence rate was 6.7 cases per 100,000 live births.

Table 1: Laboratory-Confirmed Infant Botulism Cases, CY 2002-CY 2006

					1	
Case Reports	CY 2002	CY 2003	CY 2004	CY 2005	CY 2006	
National 1	69	76	87	85	88	
Maryland ²	0	1	5	5	6	
Anne Arundel County ²	0	1	1	0	2	
¹ National figures provided by the CDC: <i>Morbity Weekly Report (MMWR)</i> Vol 56(5): 100, February 9, 2007. ² Maryland and Anne Arundel County figures provided by the Anne Arundel County Department of Health.						

Table 2: Table 2: Infant Botulism Among DOD Active-Duty Beneficiaries, CY 2002-CY 2006

Cases	CY 2002	CY 2003	CY 2004	CY 2005	CY 2006
Probable cases* Laboratory- confirmed cases Total	2 0 2	2 1 3	1 1 2	1 0 1	4 4 8
Total live births	NA	85,531	101,522	104,356	92,551
Age (months): 1 2 3 4 5 6	1 0 1 0 0	0 2 0 0 1	1 0 1 0 0	0 0 0 1 0	2 0 2 0 3 1
Gender: Female Male	1	2	0 2	0	5 3
Sponsor Service: Army Air Force Navy Marines	1 0 1 0	2 0 0 1	1 1 0 0	1 0 0 0	3 3 0 2
State: Arizona California Georgia Kansas Maryland New York North Carolina Utah Texas Washington	1 0 1 0 0 0 0	0 1 0 0 0 1 0	0 0 0 1 0 0 1	0 0 0 0 0 0 0 0	0 3 0 0 2 0 0 1 1
Quarter hospitalized: 1st 2nd 3rd 4th	1 0 1 0	1 0 3 0	0 0 1	0 0 0 1	1 4 1 2

*Probable cases are cases with clinical presentation, lacking confirmatory laboratory tests; cases were identified through International Classification of Diseases, Ninth Revision (ICD-9) diagnosis codes entered into the patient's electronic medical record during hospitalization (reference 23).

Discussion

- Both families shopped for groceries at the same commissary, as do most other families who live on Fort Meade. Still, foodborne agents were quickly ruled out due to the fact that the affected infants did not consume any food from a common source.
- Case 1 was breast-fed almost exclusively, while case 2 was fed supplement. Known food risk factors such as honey and corn syrup were never used in either case.
- The Investigation team also looked for common exposures such as public gatherings, churches, day care facilities, and parents' occupational exposures. Each of the parents work in a different setting, and none of the four came into contact with each other during the course of their work. Furthermore, neither of the families shared the same church, public places and had no known contact with each other prior to onset.
- Numerous discussions were held with leading C. botulinum experts, CDC representatives, and Maryland and Anne Arundel County public health officials about proceeding with environmental testing. The consensus of this group was that environmental testing would not confirm a link between the cases and the environment. In addition, there are no known public health prevention strategies for non-foodbome C. botulinum.
- After review of all the research and data, it is clear that there are numerous modes of ingestion of *C. botulinum* by infants that are not well demonstrated in the literature.

Recommendations

- The EPICON team recommends that—
 - The development of a library of botulism toxin B for subtyping comparisons.
- More research should be expended at looking for known risk factors for infant botulism.
- parents of newborns and infants be informed about intestinal botulism as part of child health education
- Army epidemiologists enhance surveillance for botulism cases and other RMEs
- Construction contracts serving Fort Meade and other installations require control measures to minimize dispersion of fugitive dust
- The NCR providers and clinic staff receive a message reinforcing the need to communicate reportable medical events to both civilian public health and military preventive medicine authorities

Limitations

- The first is that there was a very small number of cases (n=2).
- Secondly, the classification of C. botulinum as a select agent limits laboratory options due to special facility requirements and handling restrictions.
- The lack of a central source for identifying and tracking mortality among dependents of active-duty service members within the DOD is also problematic.

• By including all hospitalizations and outpatient encounters, DOD surveillance systems have the potential to permit calculating incidence more completely than reportable disease mechanisms, since some underreporting is typical of passive surveillance in both civilian and military sectors. Currently, however, the results codes vary across laboratories-and many botulism-related tests, in particular, are outsourced-making analysis complex and unreliable.

References

- 1. Nevas, M., Lindstrom, M., Virtanen, A., Hielm, A., Kuusi, M., Arnon, S.S., Vuori, E., Korkeala, H. 2005. "Infant botulism acquired from household dust presenting as sudden infant death syndrome." *J Clin Microbiol* 43(1):511-513.
- 2. Singh, B.R. 2000. "Intimate details of the most poisonous poison." *Nat Struct Biol* 7(8):617-619.
- 3. Pestronk A. 2005. Botulism. Neuromuscular Disease Center. [Online] http://www.neuro.wustl.edu/neuromuscular/nother/bot.htm#ref2. Accessed 1 February 2007.
- U.S. Food and Drug Administration. 2006. Foodborne Pathogenic Microorganisms and Natural Toxin Handbook: *Clostridium botulinum*. [Online] http://www.cfsan.fda.gov/~mow/chap2.html. Accessed 1 February 2007.
- 5. Centers for Disease Control and Prevention. 1998. Botulism in the United States, 1899-1996: Handbook for Epidemiologist, Clinicians, and Laboratory Workers. [Online] http://www.cdc.gov/ncidod/dbmd/diseaseinfo/files/botulism.pdf. Accessed 1 February 2007.
- Heymann, D.L. 2004. Control of Communicable Diseases Manual, 18th Ed. American Public Health Association, Washington, DC. pp. 69-75.
- 7. Luquez, C., Bianco, M.I., de Jong, L.I.T., Sagua, M.D., Arenas, G.N., Ciccarelli, A.S., Fernandez, R.A. 2005. "Distribution of Botulinum Toxin-Producing Clostridia in Soils of Argentina." Appl Environ Microbiol 71(7):4137-4139.
- 8. Wikipedia Foundation, Inc. 2007. Botulism. [Online] http://en.wikipedia.org/wiki/Botulism. Accessed 1 February 2007.
- 9. Centers for Disease Control and Prevention. 2006. Sudden Infant Death Syndrome (SIDS): Home. [Online] http://www.cdc.gov/SIDS/index.htm. Accessed 1 February 2007.
- 10. Wikipedia Foundation, Inc. 2007. Sudden infant death syndrome. [Online] http://en.wikipedia.org/wiki/Sudden_Infant_Death_Syndrome. Accessed 1 February 2007.
- 11. California Department of Health Services, Division of Communicable Disease Control. 2004. Infant Botulism Treatment and Prevention Program. [Online] http://www.infantbotulism.org/. Accessed 1 February 2007.
- 12. Chin, J., Arnon, S.S., Midura, T.F. 1979. "Food and environmental aspects of infant botulism in California." *Rev Infect Dis* 1(4):693-697.
- 13. Istre, G.R., Compton, R., Novotny, T., Young, J.E., Hatheway, C.L., Hopkins, R.S. 1986. "Infant botulism. Three cases in a small town." *Am J Dis Child* 140(10):1013-1014.
- 14. Long, S.S. 1985. "Epidemiologic study of infant botulism in Pennsylvania: Report of the Infant Botulism Study Group." Pediatrics 75:928-934

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